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Simulating control of paratuberculosis in Danish dairy herds

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Paratuberculosis

Paratuberculosis (PTB) is a chronic disease caused by *Mycobacterium avium* ssp. *paratuberculosis* (MAP). It causes economic losses and reduced animal welfare in dairy cattle herds worldwide. Animals are infected through ingested MAP shed in the feces and milk of infected animals in the same herd. Infected animals remain subclinical for a long period before they get clinical, often resulting in fatal diarrhea. Simulation models of dairy herds can be used to predict the effect of control and prevention strategies, and are especially suited for this type of slowly developing disease.

Control actions

The median within-prevalence of PTB in Danish dairy herds is around 6% and 50% of the Danish dairy cattle herds are closed (i.e. they do not purchase animals into the herd). We here simulated a closed Danish dairy herd with 200 lactating cows and a normal within-herd prevalence of PTB using the stochastic mechanistic bio-economic simulation model "iCull". Additionally, we simulated a herd with lower hygiene and thus with a higher within-herd prevalence. In the simulations we evaluated the control actions recommended in the Danish control program for PTB. These actions were: removing calves from the dam right after birth; avoiding feeding calves with colostrum from infected cows; avoiding feeding calves with colostrum from infected cows; and a strict test-and-cull strategy. From repeated simulations, the impact of each recommended action was estimated from the results. The three first-mentioned recommended actions did not have much impact on the prevalence alone, but we found a synergistic effect when combining these effects. The test-and-cull strategy was by far the most efficient action, resulting in the economically most optimal situations.

Purchase of animals

We also explored the consequences of purchasing cattle from herds possibly infected with PTB, representing the other 50% of the Danish herds that are not closed. Herds that were already infected did not have a high risk of increasing their prevalence. Herds without infected animals were highly susceptible to PTB and should avoid purchasing animals from infected herds. We also estimated the probability of fadeout of PTB once a herd was infected. This depends on the number of infected animals. If only one infected animal was purchased into a disease-free herd, we found 18% probability that the herd would still be infected after ten simulated years.